INTRODUCTION

This manual is a laboratory guide for the identification of early developmental stages of fishes of the Potomac estuary. Although developed specifically for the Potomac River Fisheries Program, it is applicable to other regions as well. It emphasizes methods of identification among families and species, describing pertinent characteristics which distinguish one species from another. Most existing references on fish eggs and larvae provide morphological descriptions of each species without comparisons to other similar forms.

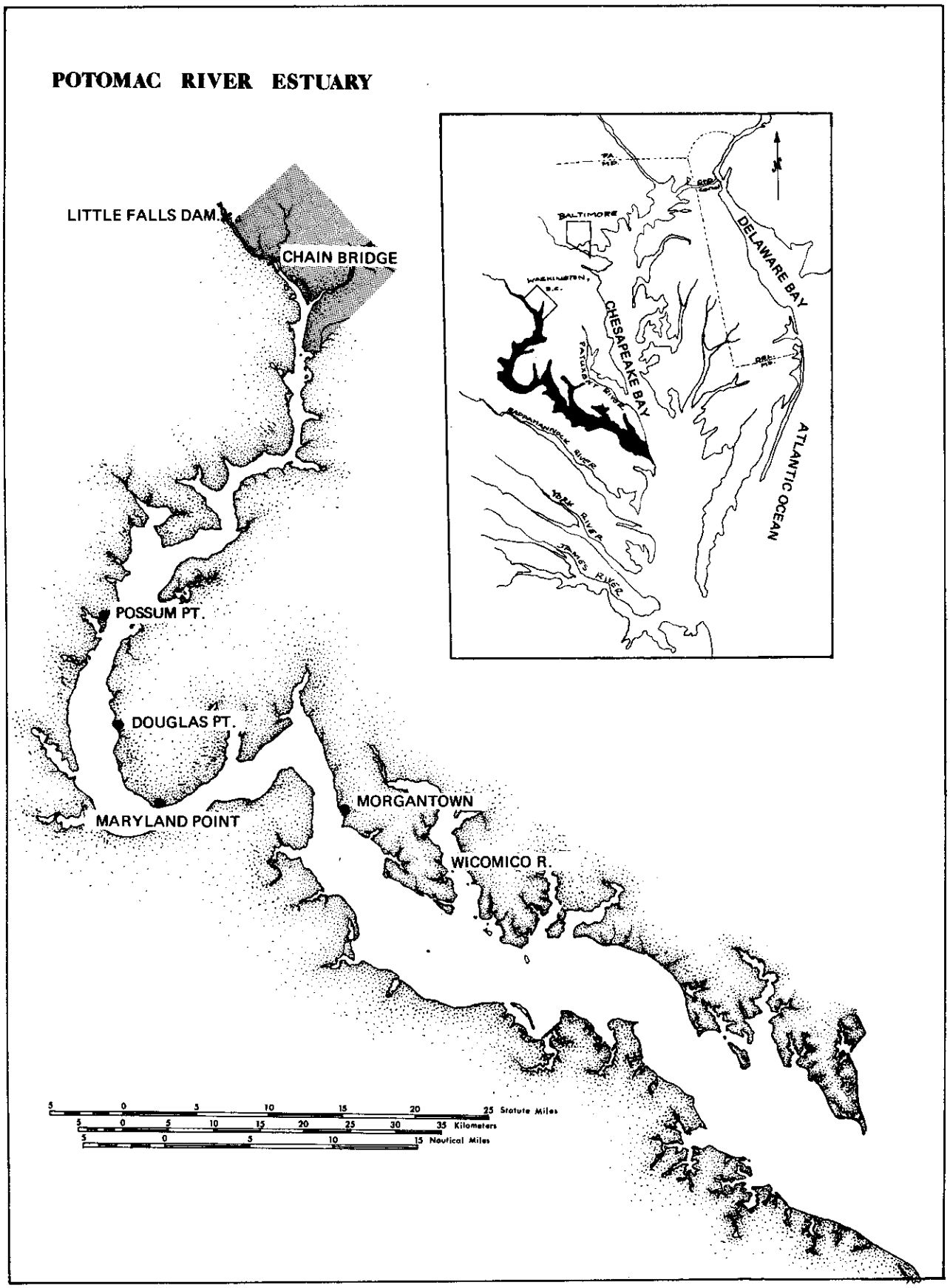
Works on early developmental stages of fishes are widely scattered in the literature, making it difficult and time-consuming to assemble adequate reference material for identification of samples. Two major compendiums of pertinent references and illustrations of regional fish eggs and larvae are available, but these do not cover all Potomac River species nor do they give enough information on comparative morphology. However, both these publications, Development of Fishes of the Chesapeake Bay Region; Part I, (Mansueti and Hardy, 1967) and Pictorial Guide to Fish Larvae of Delaware Bay, (Scotton, et al., 1973) are valuable references which well serve their respective purposes.

The first includes a comprehensive literature survey and morphological and meristic descriptions of all species distributed within the Chesapeake Bay region from upper tidal freshwaters of the Bay and its tributaries to marine waters of the Atlantic shelf. Part I includes descriptions of species in families Acipenseridae through Ictaluridae (14 families) and is the first of a continuing series which ultimately will include all families of the region. The format of the Delaware Bay guide is similar but with more emphasis on mesohaline to marine forms. In addition to descriptions of 56 species in 24 families, it has substantive chapters on laboratory and field sampling methodologies. We have not included a discussion of laboratory techniques in this manual since this subject is well covered both in the Delaware publication and in a paper by Richards and Berry (1973) which appears in "Proceedings of a workshop on egg, larval, and juvenile stages of fish in Atlantic Coast Estuaries" (Pacheco, 1973).

All fish species in our manual are those whose early developmental stages are likely to be distributed within tidewaters of the Potomac River estuary. The Potomac estuary is defined as that portion of the river from the uppermost limit of tidal influence just above Washington, D.C. to its mouth at its confluence with the Chesapeake Bay, including all tributary streams as far as their tidal limits (see map).

Distributed within the Potomac River estuary are estuarine, freshwater, and marine fishes. Estuarine fishes are those whose adults are normally distributed throughout most of the estuary, and include anadromous species which spawn upstream in tidal-fresh and low-brackish waters (herrings, shad, white perch, striped bass), species which spawn further downstream in moderate salinities (hogchoker, anchovies), and more ubiquitous species which spawn throughout the estuary (silversides, killifishes).

Freshwater fishes include those commonly found in fresh and tidal-fresh waters, some of which are highly tolerant of saline conditions, penetrating far downstream often spawning in estuarine waters (carp, golden



shiner). Others which are less tolerant (pumpkinseed, quillback) confine their spawning to strictly freshwater. Occasionally, the later species spawn so close to tidal boundaries that larvae and juveniles often stray into tidal regions.

Marine fishes are those ocean species which spawn at sea or at the mouth of the Chesapeake Bay but whose larvae migrate into the estuary soon after hatching. The young stages of some species (croaker, menhaden) often move far upstream into low-salinity areas occupied by larvae of anadromous fishes. Others (harvestfish, silver perch) are more limited in their movement and are found only as stragglers in the higher salinity waters at the mouth of the river.

In our final listing, we have attempted to be as comprehensive as possible by including all species within each category which occur either commonly or rarely in the Potomac River.

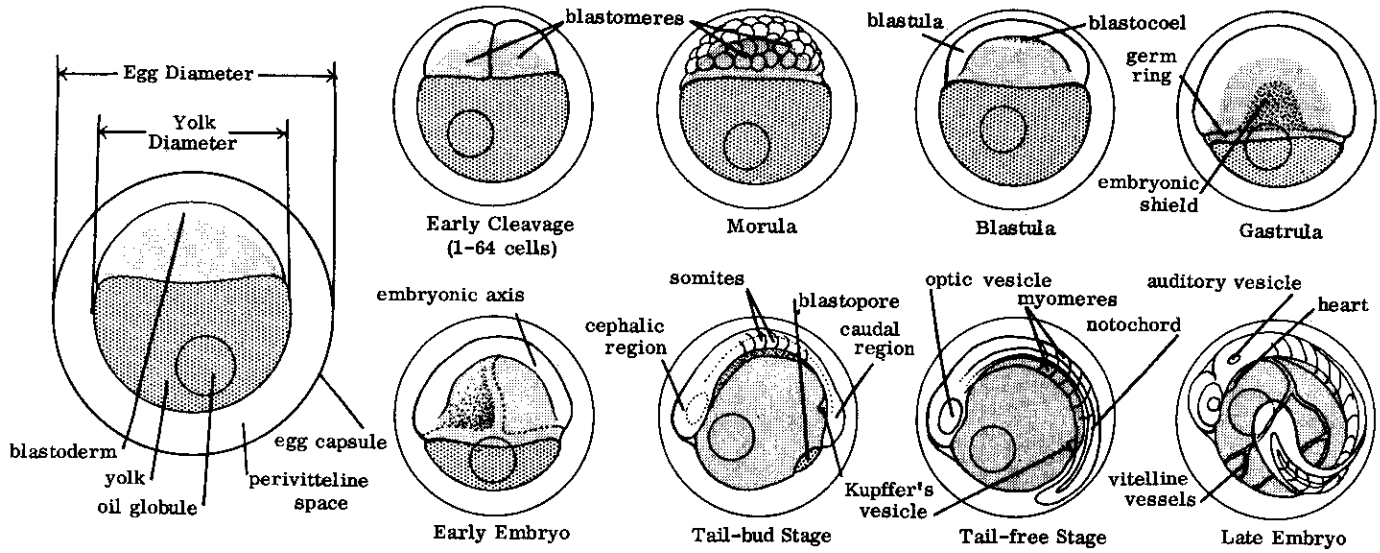
Species selection has, of necessity, been somewhat arbitrary. Previous to the compilation of the manual there had not been any intensive river-wide ichthyoplankton survey on which to base our selections. The final list has been compiled principally on the basis of historical records of adult, juvenile or larval distributions within Potomac tidewaters. Some inclusions are made because of known egg and larval distributions from plankton collections in other areas of Chesapeake Bay with similar habitats and salinity regimes (Dovel, 1971). The manual describes 88 species in 33 families, of which 38 are estuarine, 30 freshwater, and 20 marine, according to our definitions above. We have followed the nomenclature in A List of Common and Scientific Names of Fishes from the United States and Canada, Third Edition, 1970, American Fisheries Society, Special Publication No. 6 with one exception: we have retained the halfbeaks in family Hemiramphidae, rather than placing them in family Exocoetidae. Other recent taxonomic changes are noted under the species descriptions.

To assist in the preliminary sorting of specimens, we have prepared a tabular summary (p. 6) of all species, with notations on spawning location in relation to salinities, season, and habitat and general larval distributions. Looking at both the site and season of collection of a specimen is often as helpful to quick identification as morphological details. In addition, we have prepared a pictorial guide to distinguishing characteristics of families (p. 12). In order to promptly identify at least to the family level, the experienced worker relies heavily on basic body form and proportions, position of vent in relation to total length, and pigmentation patterns. The family guide is primarily a synopsis of these basic characteristics.

Although pigmentation patterns are utilized throughout, care must be exercised in using pigmentation as a definitive identifying character. Pigmentation is often variable within a species and also highly susceptible to marked regional differences. Furthermore, melanophores and other pigmentation frequently fade under preservation.

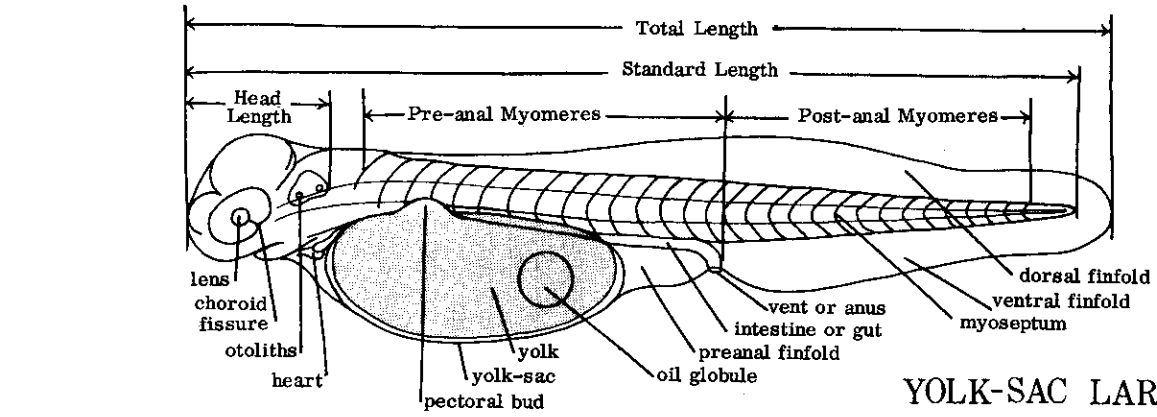
A key for identification of all species and all stages is not attempted because of many gaps in our knowledge of early life history stages and the inherent problems of dealing with constantly changing morphometry and meristics through egg, yolk-sac larval, and larval stages.

Diagrammatic Representation of Morphology and Development of Egg and Larval Stages of a Typical Teleost

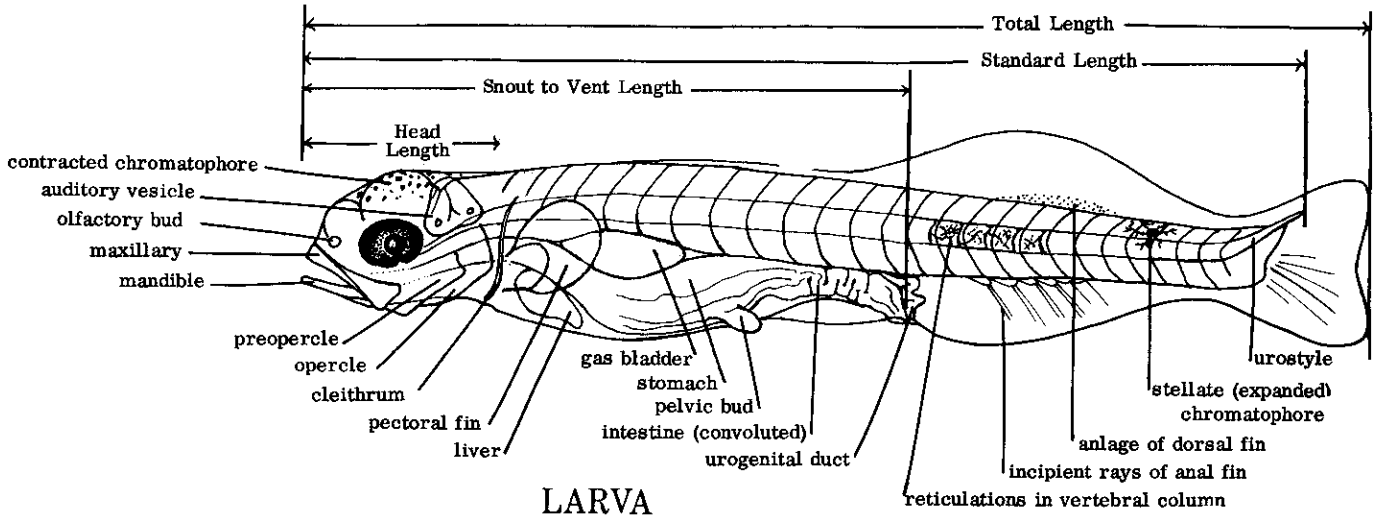


EGG STRUCTURE

EGG DEVELOPMENT



YOLK-SAC LARVA



LARVA

Before species identifications of fish eggs or larvae can be made, the basic morphological and meristic characteristics of these organisms must be understood. A diagram of the anatomy and development of egg and larval stages of a typical teleostean fish, reprinted from Mansueti and Hardy (1967), shows the principal structures and generalized form of a fish egg and larva. Our usage of names of anatomical features and methods of counting and measuring follow those in Mansueti and Hardy (1967). Unless otherwise noted, all length measurements are given as total lengths. Anatomical, meristic, and developmental terms and abbreviations used are listed in the Terminology section. For those who are entirely unfamiliar with details of early fish development and the characteristics which are most useful in the study of larval fishes, we recommend the discussion of such in Berry and Richards (1963).

Format of Text

Species are grouped by family. Each major family group begins with a review of the regional species within that family. Following is a discussion of characteristics which identify an egg or larva to a family and then to the species within that family. Wherever possible, we have included family keys or tabular outlines for species separation.

Individual species descriptions succeed the family discussion and include a brief review of spawning habits and identifying characteristics of egg, larval, and juvenile stages. Prejuveniles, as defined in Mansueti and Hardy (1969), are included under larvae. Adult meristics and other characteristics of the fully mature stage are summarized. Fin ray and spine counts are expressed in the usual manner with roman numerals indicating spines, arabic numbers indicating soft rays. Hyphenation denotes the range of possible counts. A comma separates spine and soft-ray counts of a fin and also the division between first and second dorsal fins.

We have opted not to reference each statement in the text, but to place all references as well as sources of illustrations at the end of each species summary. In most instances, the reference list is so short that a numbering system did not seem necessary. Generally, comparative comments originate with the authors, while specific details on morphology come either from referenced works or again from the authors. In some cases, for the sake of clarity, abbreviated references are incorporated within the text as are personal communications or information that has been directly assimilated from the 1974 Ichthyoplankton Workshop. Full references are found in the bibliography.

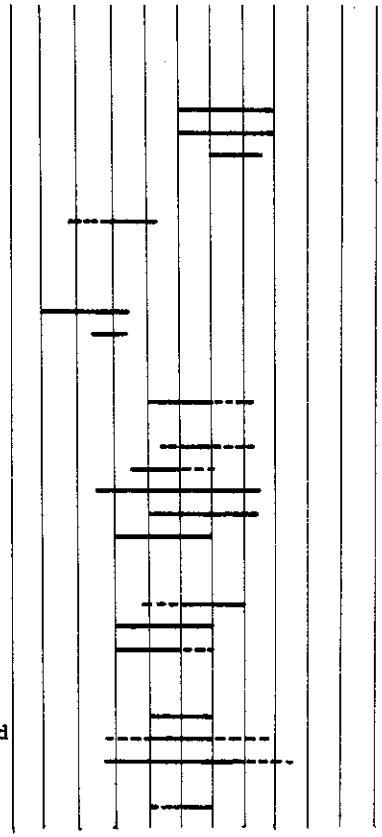
POTOMAC RIVER FISH EGGS AND LARVAE

	EGGS[1]						SPAWNING[2]												LARVAE			
	Freshwater	Estuarine	Marine	Pelagic	Demersal	Habitat	J	F	M	A	M	J	J	A	S	O	N	D	Freshwater	Estuarine	Marine	Habitat
Acipenseridae-sturgeons																						
Atlantic sturgeon-*Acipenser oxyrhynchus*	x	x			x	Attached				———	———								x	x		In shallows, weeds
Lepisosteidae-gars																						
Longnose gar-*Lepisosteus osseus*	x				x	Attached					———	———							x			Yolk-sac larvae attached to vegetation
Anguillidae-freshwater eels																						
. American eel-*Anguilla rostrata*			x	x		Ocean	- - -	- - -									- - -	- - -		x	x	Occasional leptocephalus in estuaries
Congridae-conger eels																						
Conger eel-*Conger oceanicus*			x	x		Ocean														x	x	Occasional leptocephalus in estuaries
Ophichthyidae-snake eels																						
Speckled worm eel-*Myrophis punctatus*			x			Ocean														x	x	Occasional leptocephalus in estuaries
Clupeidae-herrings																						
. Blueback herring-*Alosa aestivalis*	x			x	x	Potomac & tributaries				—	—								x	x		Open waters
. Hickory shad-*Alosa mediocris*	x			x	x	"					—	—							x	x		"
. Alewife-*Alosa pseudoharengus*	x			x	x	"			—	—									x	x		"
. American shad-*Alosa sapidissima*	x			x		Mainstream of Potomac				—	—								x	x		"
. Atlantic menhaden-*Brevoortia tyrannus*		x	x	x		Ocean, estuary	—					- - -	- - -	- - -			- - -			x	x	"
Atlantic herring-*Clupea harengus*			x	x		Ocean									———	———				x	x	"
. Gizzard shad-*Dorosoma cepedianum*	x				x	Usually in quiet shallows						———	- - -						x			
Threadfin shad-*Dorosoma petenense*	x				x	Shallows over vegetation				—	—	—	- - -						x			

Engraulidae-anchovies												
Striped anchovy-*Anchoa hepsetus*		x	x	x		Lower Bay				x	x	Open waters
. Bay anchovy-*Anchoa mitchilli*		x		x		Open waters				x		"
Silver anchovy-*Engraulis eurystole*			x	x		Ocean				x	x	"
Umbridae-mudminnows												
Eastern mudminnow-*Umbra pygmaea*	x				x	Nest			x			Remain in nest ca. 1 week after hatching
Esocidae-pikes												
Redfin pickerel-*Esox americanus*	x				x	Grassy tidal pools			x			Among vegetation
Chain pickerel-*Esox niger*	x				x	"			x			"
Cyprinidae-minnows and carps												
Goldfish-*Carassius auratus*	x				x	Attached			x	x		Yolk-sac larvae cling to bottom in vegetation
. Carp-*Cyprinus carpio*	x	x			x	"			x	x		"
. Silvery minnow-*Hybognathus nuchalis*	x				x	"			x	x		"
Golden shiner-*Notemigonus crysoleucas*	x				x	"			x	x		"
Satinfin shiner-*Notropis analostanus*	x				x	"			x			Slow moving shallows
. Spottail shiner-*Notropis hudsonius*	x				x	Scattered over bottom			x	x		
Catostomidae-suckers												
Quillback - *Carpiodes cyprinus*	x				x	Scattered over bottom			x			
. White sucker-*Catostomus commersoni*	x				x	Attached			x			Schooling in shallows
. Creek chubsucker-*Erimyzon oblongus*	x				x	"			x			
Ictaluridae-freshwater catfishes												
. White catfish-*Ictalurus catus*	x				x	Nest, stone or gravel			x			Dense schools
. Brown bullhead-*Ictalurus nebulosus*	x				x	Nest, stone, gravel, mud			x			"
. Channel catfish-*Ictalurus punctatus*	x				x	Attached, gelatinous mass			x			"
Margined madtom-*Noturus insignis*	x				x	Attached in masses			x			

[1] This applies to tidal freshwater and low brackish waters to 2-3 ppt.

. Species that can be considered of common occurrence within the Potomac tidewater region.



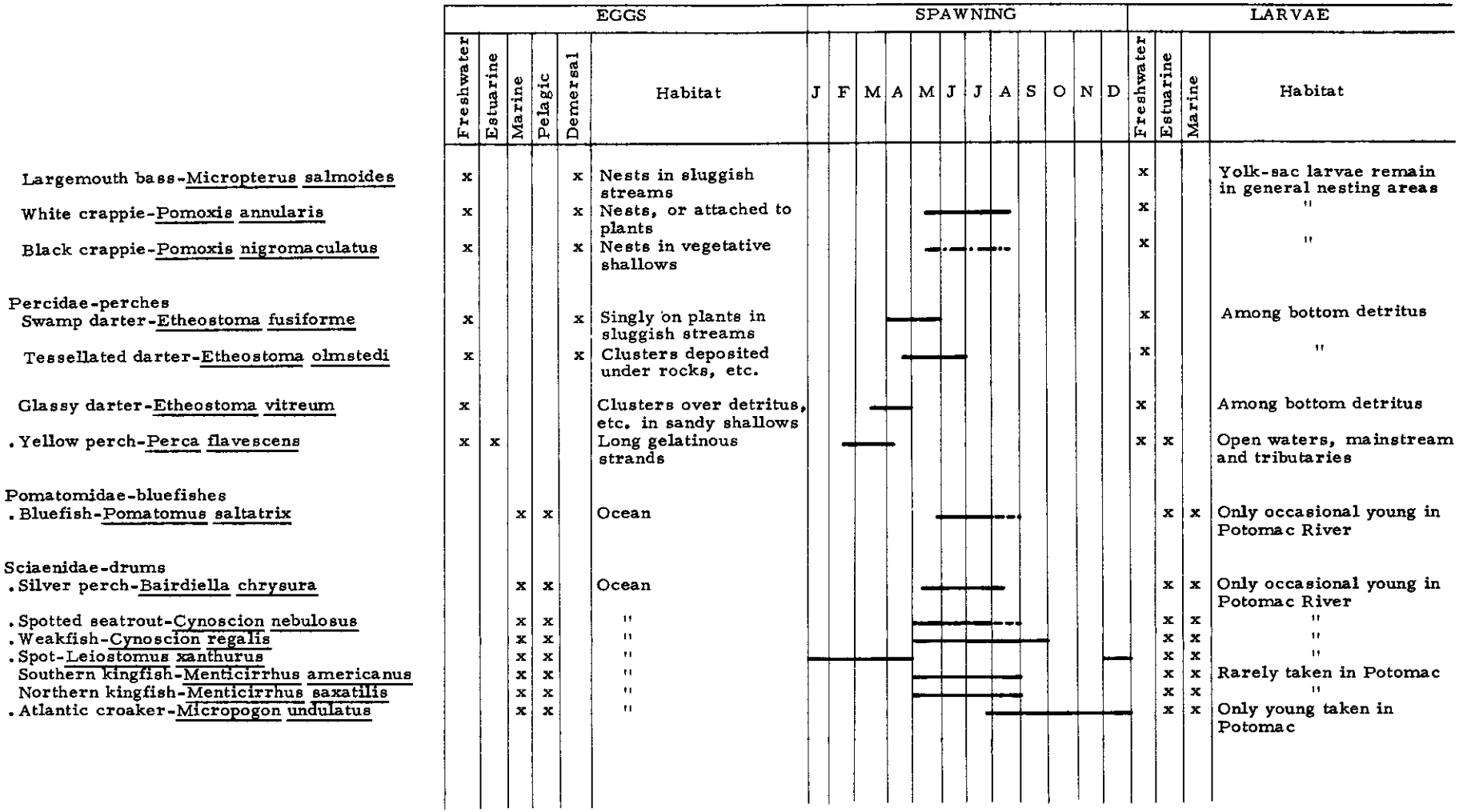
Known spawning season

Possible extension of spawning seasons

Uncertain spawning season

	EGGS						SPAWNING												LARVAE			
	Freshwater	Estuarine	Marine	Pelagic	Demersal	Habitat	J	F	M	A	M	J	J	A	S	O	N	D	Freshwater	Estuarine	Marine	Habitat
Batrachoididae-toadfishes																						
. Oyster toadfish-Opsanus tau		x			x	Attached				—	—	—	—							x	x	Yolk-sac larvae remain attached in oyster beds
Gobiesocidae-clingfishes																						
. Skilletfish-Gobiesox strumosus		x	x		x	Attached, usually on shells				-	—	—	—	-						x	x	Larvae closely associated with oyster beds
Hemiramphidae - halfbeaks																						
Ballyhoo-Hemiramphus brasiliensis		?	?	x		Ocean						·	·	·	·					x	x	In open waters
Halfbeak-Hyporhamphus unifasciatus			?	x									·	·	·					x	x	"
Belonidae-needlefishes																						
. Atlantic needlefish-Strongylura marina		x	x	x		Attached to submerged vegetation					—	—								x	x	Along sandy and vegetative shores
Cyprinodontidae-killifishes																						
. Sheepshead minnow-Cyprinodon variegatus	x	x	x		x	Vegetative shallows, mud					—	—	—	—						x	x	Among vegetation in shallows
. Banded killifish-Fundulus diaphanus	x	x			x	Vegetative shallows				—	—	—	—	—					x	x		"
. Mummichog-Fundulus heteroclitus	x	x			x	"				—	—	—	—	—					x	x		"
. Striped mummichog-Fundulus majalis	x	x	x		x	Buried high in intertidal sand				—	—	—	—	—					x	x		
Rainwater killifish-Lucania parva	x	x			x	Vegetative shallows				—	—	—	—	—					x	x		Among vegetation in shallows
Poeciliidae-livebearers																						
Mosquitofish-Gambusia affinis						Livebearers				—	—	—	—	—					x	x	x	Juveniles born in vegetative shallows near surface or on bottom

Atherinidae-silversides															
Rough silverside-Membras martinica		x	x		x	Attached to vegetation						x	x	Large schools in vegetative shallows
. Tidewater silverside-Menidia beryllina	x	x			x	"					x	x		"
. Atlantic silverside-Menidia menidia		x	x		x	"						x		"
Gasterosteidae-sticklebacks															
Fourspine stickleback-Apeltes quadracus	x	x	x		x	Algal nests					x	x	x	Usually among dense rooted aquatics
Threespine stickleback-Gasterosteus aculeatus	x				x	"					x	x		"
Syngnathidae-pipefishes and seahorses															
Lined seahorse-Hippocampus erectus						Carried in male's pouch until juvenile stage						x	x	Juveniles found along shore
Dusty pipefish-Syngnathus floridae						"						x	x	"
. Northern pipefish-Syngnathus fuscus						"						x	x	"
Percichthyidae-temperate basses															
. White perch-Morone americana	x	x		x	x	Most tributaries, to narrow tidal-fresh streams					x	x		Open waters, mainstream and tributaries
. Striped bass-Morone saxatilis	x	x		x		Rapidly flowing waters near fresh/ salt interface						x		Open waters, Potomac mainstream
Serranidae-sea basses															
Black sea bass-Centropristes striata			x	x		Ocean or lower Bay						x	x	Open waters
Centrarchidae-sunfishes															
Bluespotted sunfish-Enneacanthus gloriosus	x				x	Nests in vegetative shallows					x			Yolk-sac larvae remain in general nesting areas
Redbreast sunfish-Lepomis auritus	x				x	Nests in shallows just above freshwater interface					x			"
. Pumpkinseed-Lepomis gibbosus	x				x	Nests, or attached to vegetation					x			"
Bluegill-Lepomis macrochirus	x				x	Nests in nonvegetative shallows					x			"
Longear sunfish-Lepomis megalotis	x				x	Nests in calm water over rocks or sand					x			"
Smallmouth bass-Micropterus dolomieui	x				x	Nests in gravel near shore					x			"



	EGGS						SPAWNING												LARVAE			
	Freshwater	Estuarine	Marine	Pelagic	Demersal	Habitat	J	F	M	A	M	J	J	A	S	O	N	D	Freshwater	Estuarine	Marine	Habitat
Largemouth bass-Micropterus salmoides	x				x	Nests in sluggish streams													x			Yolk-sac larvae remain in general nesting areas
White crappie-Pomoxis annularis	x				x	Nests, or attached to plants													x			"
Black crappie-Pomoxis nigromaculatus	x				x	Nests in vegetative shallows													x			"
Percidae-perches																						
Swamp darter-Etheostoma fusiforme	x				x	Singly on plants in sluggish streams													x			Among bottom detritus
Tessellated darter-Etheostoma olmstedi	x				x	Clusters deposited under rocks, etc.													x			"
Glassy darter-Etheostoma vitreum	x					Clusters over detritus, etc. in sandy shallows													x			Among bottom detritus
. Yellow perch-Perca flavescens	x	x				Long gelatinous strands													x	x		Open waters, mainstream and tributaries
Pomatomidae-bluefishes																						
. Bluefish-Pomatomus saltatrix			x	x		Ocean														x	x	Only occasional young in Potomac River
Sciaenidae-drums																						
. Silver perch-Bairdiella chrysura			x	x		Ocean														x	x	Only occasional young in Potomac River
. Spotted seatrout-Cynoscion nebulosus			x	x		"														x	x	"
. Weakfish-Cynoscion regalis			x	x		"														x	x	"
. Spot-Leiostomus xanthurus			x	x		"														x	x	"
Southern kingfish-Menticirrhus americanus			x	x		"														x	x	Rarely taken in Potomac
Northern kingfish-Menticirrhus saxatilis			x	x		"														x	x	"
. Atlantic croaker-Micropogon undulatus			x	x		"														x	x	Only young taken in Potomac

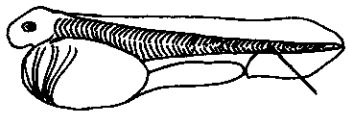
Black drum-Pogonias cromis		x	x		Ocean				x	x	Only young taken in Potomac
Red drum-Sciaenops ocellata		x	x		"				x	x	"
Blenniidae-combtooth blennies											
. Striped blenny-Chasmodes bosquianus	x	x		x	Attached to empty oyster shells etc. in single layer				x	x	Oyster beds
Feather blenny-Hypsoblennius hentzi	x	x		x	"			x	x		"
Gobiidae-gobies											
Darter goby-Gobionellus boleosoma	x	x		x	Attached to oyster shells or other hard substrate				x	x	Benthic species, often on oyster beds
. Naked goby-Gobiosoma bosci	x			x	"				x		"
Seaboard goby-Gobiosoma ginsburgi	x	x		x	"				x	x	"
Green goby-Microgobius thalassinus	x	x		x	Attached to oyster shells or other hard substrate				x	x	Benthic species, often on oyster beds
Stromateidae-butterfishes											
. Harvestfish-Peprilus alepidotus	?	x	x		Lower Bay and ocean				x	x	Open waters
Butterfish-Peprilus triacanthus	?	x	x		"				x	x	"
Pleuronectidae-righteye flounders											
Winter flounder-Pseudopleuronectes americanus	x	x		x	Sandy shores in Bay and lower Potomac				x	x	Along sandy bottoms
Soleidae-soles											
Hogchoker-Trinectes maculatus	x	x	x		Oriented towards bottom in estuary				x	x	Near or on bottom
Tetraodontidae - puffers											
Northern puffer-Sphaeroides maculatus	x	x		x	Attached or in clusters in deep water				x	x	

Distinguishing Family* Characteristics Among Potomac River Fish Larvae

Yolk-sac Larvae Larvae

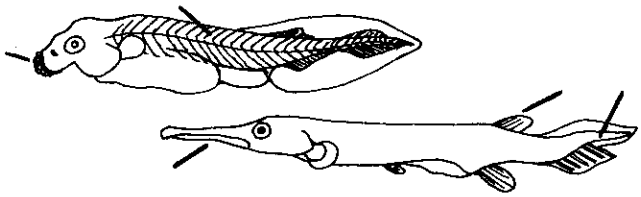
Acipenseridae - sturgeons

Large size; dense opaque larvae; very high myomere count.



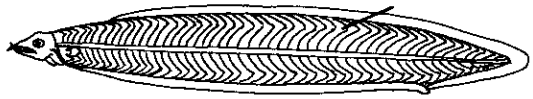
Lepisosteidae - gars

Sucking disc; dense, opaque larvae, high myomere count; heterocercal tail; posterior dorsal and anal fins; elongate snout.

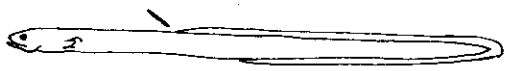


Anguillidae - freshwater eels

Leptocephalus: low myomere count (104-111); small size (only to 65 mm)

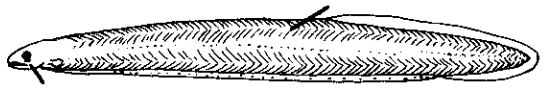


Transforming eel: low myomere count, origin of dorsal fin posterior to mid-point between gill opening and vent.

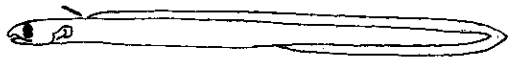


Congridae - conger eels

Leptocephalus: high myomere count (140-149); large size (to 160mm); crescent shaped patch under eye.

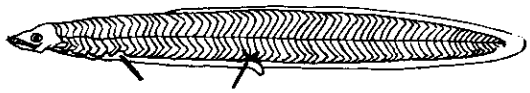


Transforming eel: high myomere count, origin of dorsal anterior, just posterior to pectorals.



Opichthidae - snake eels

Leptocephalus: high myomere count, small size (ca. 70 mm), third gut swelling prominent; crescent shaped liver over vent.



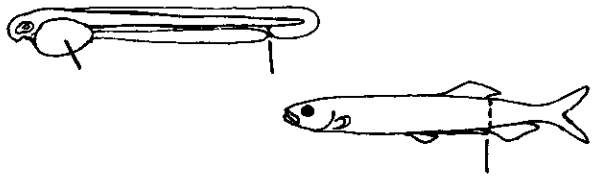
Glass eel: high myomere count, origin of dorsal fin midway between gill opening and vent.

*Typical body form representative of the family used except where only one species of the family is included in this manual. In this case the illustration is species specific.

Yolk-sac Larvae Larvae

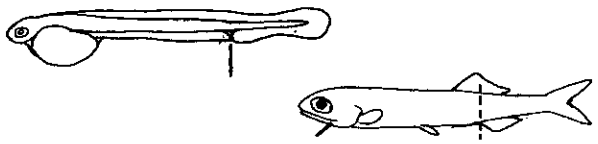
Clupeidae - herrings

Long, slender larvae; yolk-sac smallish, anterior; vent well posterior; anal fin origin posterior to dorsal fin.



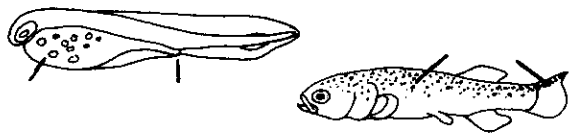
Engraulidae - anchovies

Long, slender larvae; vent posterior but less so than in clupeids; dorsal fin overlaps anal fin origin; gape extends beyond eye.



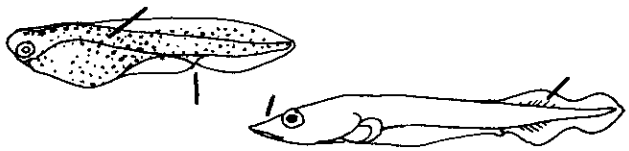
Umbridae - mudminnows

Vent slightly posterior to mid-body; yolk with many oil globules; thick, darkened urostyle extends to posterior margin of caudal fin; larvae heavily peppered with melanophores.



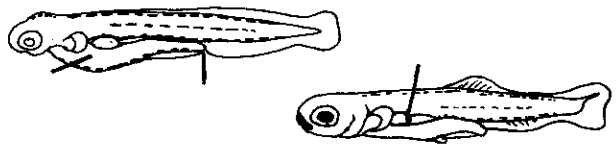
Esocidae - pikes

Heavy yolk-sac larvae, densely pigmented; vent ca. 2/3 back on body; larvae elongate with extended depressed snout; posterior dorsal and anal fins.



Cyprinidae - minnows and carps

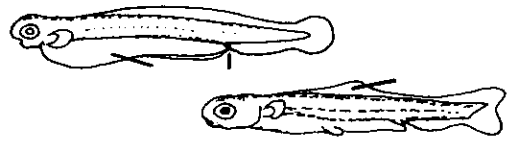
Yolk-sac anteriorly spherical, posteriorly cylindrical; vent usually slightly beyond mid-body; single dorsal fin; air bladder obvious becoming 2-chambered with growth and usually pigmented dorsally. Pigmentation often in rows; dorsolaterally, mid-laterally, along ventral margin of myomeres, and mid-ventrally on abdomen.



Yolk-sac Larvae Larvae

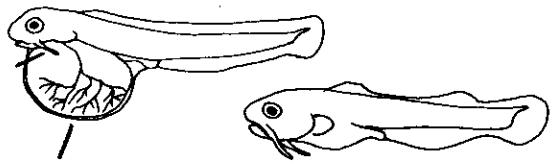
Catostomidae - suckers

Recently hatched larvae with long cylindrical yolk, more bulbous anteriorly; vent posterior 2/3-3/4 back on body; single dorsal fin but with more rays than cyprinids; three rows of pigment (variable); inferior mouth (later stages); air bladder 2-chambered with growth.



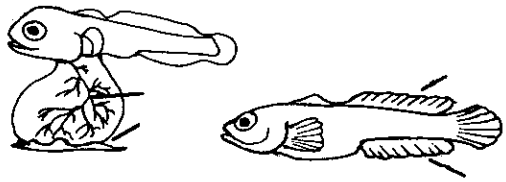
Ictaluridae - freshwater catfishes

Barbels evident at hatching; large bulbous yolk; vitelline vessels often evident over yolk, larvae adult-like.



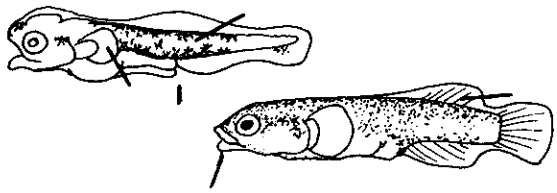
Batrachoididae - toadfishes

Large robust larvae; yolk-sac larvae attached to substrate, vitelline vessels over yolk, long fleshy dorsal and anal fins; larvae adult-like.



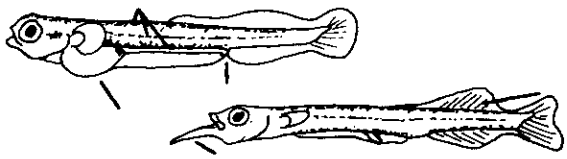
Gobiesocidae - clingfishes

Vent slightly beyond mid-body, heavy pigmentation from mid-caudal region forward, wide pectorals; later larvae robust, single dorsal fin, large mouth, fleshy lips.



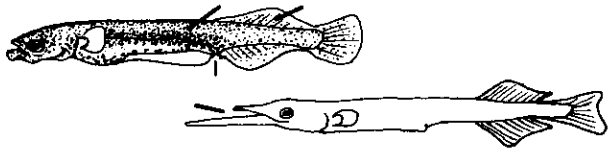
Hemiramphidae - halfbeaks

Long slender larvae, vent ca. 2/3 back on body; yolk small anteriorly; both jaws abbreviated at hatching, lower jaw elongates with growth; pigmentation in lines along dorsal margin, mid-laterally; single posterior dorsal fin.



Belonidae - needlefishes

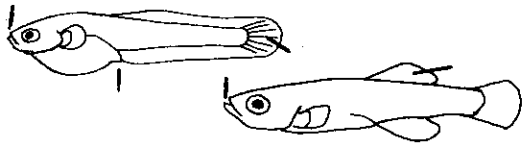
Long slender larvae, vent ca. 2/3 back on body, both jaws abbreviated at hatching, elongating with growth; whole body densely peppered with melanophores, single posterior dorsal fin.



Yolk-sac Larvae Larvae

Cyprinidontidae - killifishes

Stubby, robust larvae; vent anterior, ca. 2/5 distance back on body, immediately posterior to yolk; caudal fin with rays at hatching; mouth small, superior; single dorsal.

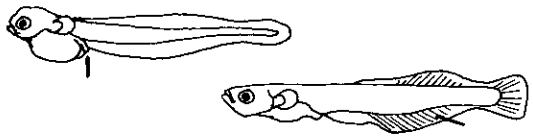


Poeciliidae - livebearers

Larvae with scales and rays in all fins at birth; mouth small, superior; short single dorsal fin (7-8 rays vs. 10 or more in cyprinidonts).

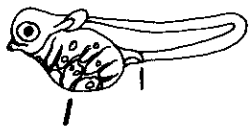
Atherinidae - silversides

Long slender larvae, vent anterior, ca. 1/4 back on body; preanal finfold absent or vestigial; 2 dorsal fins, 1st dorsal small; anal fin long.



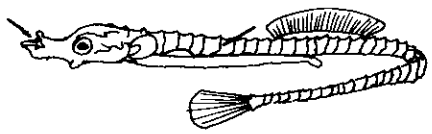
Gasterosteidae - sticklebacks

Short, stubby larvae; vent at mid-body or slightly posterior; vitelline vessels over yolk; few small oil globules.



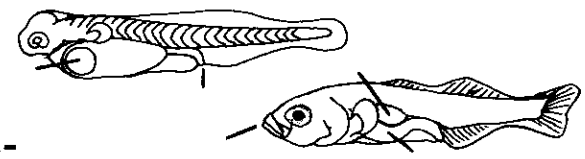
Syngnathidae - pipefishes and seahorses

Unique larvae, bony ridges on head and body; small mouth at end of truncated snout; bony rings around body.



Percichthyidae - temperate basses

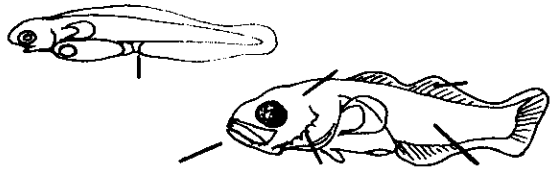
Vent slightly posterior to mid-body single large oil globule in anterior of yolk; myomere count moderate (23-26); later larvae with well developed mouth, teeth; air bladder obvious, uncoiled gut; 1st dorsal fin develops secondairly and is at least, initially, separate from 2nd dorsal.



Yolk-sac Larvae Larvae

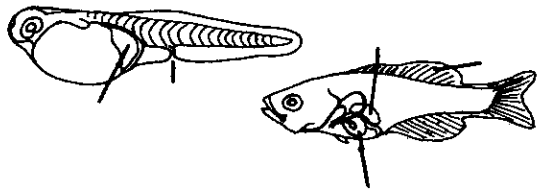
Serranidae - sea basses

Small yolk-sac larvae (1.5-2 mm); oil globule in anterior of yolk; larvae with large heads, stout bodies, large mouth with many teeth; vent at mid-body; opercular and preopercular spines; 2nd dorsal short (11 vs. 20 or more in sciaenids).



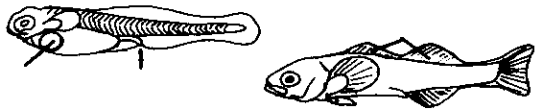
Centrarchidae - sunfishes

Vent slightly anterior to mid-body, single large oil globule in yolk; air bladder distinct, gut coils with growth; spinous and soft dorsal fins continuous.



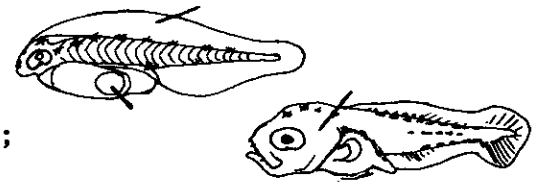
Percidae - perches

Vent at mid-body; single large oil globule in anterior of yolk; myomere count high (usually 30-40); 2 separate dorsal fins.



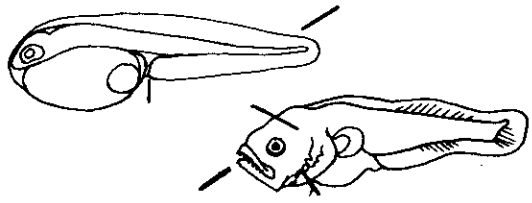
Pomatomidae - bluefishes

Vent in yolk-sac larvae posterior to mid-body, becoming anterior with development; dorsal finfolds broad, extending to cerebellum; single large oil globule in posterior of yolk; 24 myomeres; head large and bulbous in appearance.



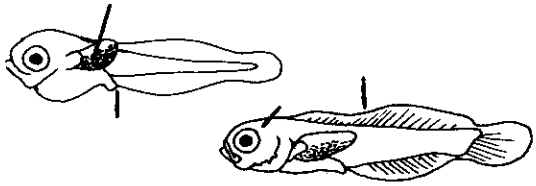
Sciaenidae - drums

Vent well anterior to mid-body; tail long and tapered in yolk-sac stage; larvae with large heads, large steeply angled mouths with prominent small teeth; truncated body; usually with prominent preopercular spines.



Blenniidae - combtooth blennies

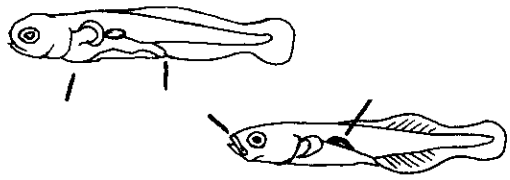
Short stubby yolk-sac larvae, vent well anterior in thoracic region; large pigmented pectorals; head large and rounded; spinous and soft dorsals long and continuous, anal fin long; well defined preopercular spines.



Yolk-sac Larvae Larvae

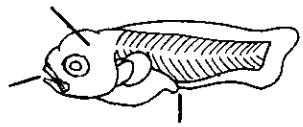
Gobiidae - gobies

Vent at mid-body or slightly posterior; yolk small and anterior at hatching; larvae with pointed snout; prominent air bladder dorsally pigmented; little pigment over body; 1st dorsal develops much later than other vertical fins.



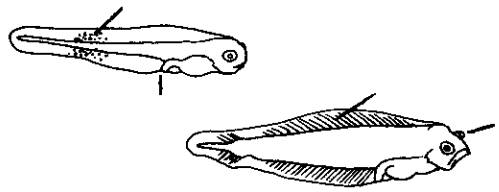
Stromateidae - butterfishes

Short stubby larvae, large head; vent at mid-body or slightly posterior; myomeres ca. 30 (higher number than in bluefish); mouth small.



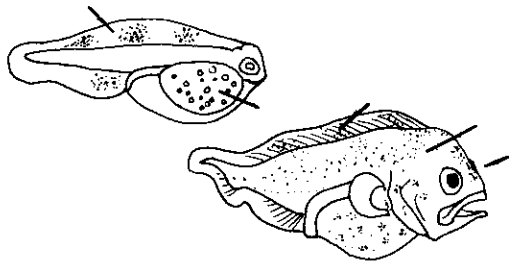
Pleuronectidae - righteye flounder

Long slender larvae; vent anterior; ca. 1/3 or less back on body; finfolds broad and slightly pigmented; long dorsal and anal fins with many rays (D. 60-76; A. 45-48); left eye migrates to right side.



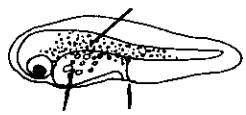
Soleidae - soles

Vent anterior to mid-body (variable with age); finfold broad and pigmented in bands; many small oil globules in yolk; larvae deep, flat; head large; long dorsal and anal fins (D. 50-56, A. 36-42); left eye migrates to right side.



Tetraodontidae - puffers

Short stubby larvae, vent slightly anterior to mid-body; yolk with many small oil globules, heavily pigmented; body covered with fine tubercles, becoming truncated with development; vertical fins posterior.



TERMINOLOGY

A Abbreviation for anal fin.

abdominal vertebra A vertebra with only a neural arch, no haemal arch, usually anterior to vent.

adhesive egg An egg which adheres on contact to substrate material or other eggs; adhesiveness of entire egg capsule may or may not persist after attachment.

adipose fin Fleshy, rayless fin on dorsal ridge between dorsal and caudal fins.

air bladder Membranous, gas-filled organ located between the kidneys and alimentary canal in teleosts; gas bladder or swim bladder.

anadromous Designating fish which ascend rivers from the sea to spawn.

anal That which pertains to the anus or vent.

anal fin The unpaired median fin immediately behind anus or vent.

anal origin The anterior-most point at which the anal fin attaches to the body.

anus External orifice of the intestine; vent.

auditory vesicle Sensory primordium from which the ear develops; clearly evident during early development.

axillary process Enlarged, accessory scale attached to the upper or anterior base of pectoral or pelvic fins in certain fishes.

barbel A fleshy, tactile, elongated process or filament, usually located on lips, chin, or nose of certain fishes.

blastoderm Strictly defined as early embryonic tissue composed of blastomeres; generally used to designate embryonic tissue until formation of embryonic axis.

blastodisc Embryo-forming site of the egg prior to cleavage.

blastula Stage in embryonic development which represents the final product of cleavage stages, characterized by formation of the cavity of the blastula.

branched ray Soft ray with two or more branches distally.

branchial arches Bony or cartilaginous structures, located on each side of the pharynx, that support the gills.

branchiostegals Elongated bones arranged fan-wise within the branchiostegal membrane; branchiostegal rays.

buoyant egg An egg that floats freely within the water column; pelagic.

caudal fin Tail fin of fishes.

caudal peduncle Area of a fish between posterior end of anal fin base and base of caudal fin.

caudal vertebra A vertebra with both a neural and a haemal arch; usually posterior to vent.

cheek Lateral surface of head between eye and opercle, usually excluding preopercle.

chromatophore Pigment-bearing cell; frequently capable of expansion and contraction which changes its size, shape and color.

cleavage stages Initial stages in embryonic development where division of blastomeres is clearly marked; usually includes 1st through 6th cleavages (2-64 cells).

cleithrum Prominent bone of pectoral girdle, clearly visible in many larvae.

D Abbreviation for dorsal fin(s).

demersal egg An egg which remains on the bottom, either free or attached to substrate material.

dorsal fin(s) Unpaired, rayed, median fin(s) located on the back.

dorsal origin Point where first dorsal ray or spine attaches to body.

early embryo Stage in embryonic development characterized by formation of embryonic axis.

egg capsule Outermost encapsulating structure of the egg, consisting of one or more membranes; the protective shell.

egg size In essentially spherical eggs, the greatest diameter of the egg capsule. In obviously elliptical eggs, two measurements are given: the length of the longest axis, the major axis; the length of the shortest axis, the minor axis.

emarginate Notched but notdefinitely forked, as in the shallowly notched caudal fin of some fishes.

embryonic axis Primitive differentiation of the embryo; an elongate thickening of blastodermal tissue.

falcate Deeply concave, as a fin with middle rays much shorter than anterior and posterior rays.

finfold Median fold of integument which extends along body of developing fishes and from which median fins arise.

gastrula Stage in embryonic development between blastula and formation of embryonic axis.

germ ring The thickened rim of the blastoderm evident during late blastula and gastrula stages.

germinal disc The blastodisc.

gill arch The branchial skeleton supporting the gill rakers and filaments.

gill rakers Variously shaped bony projections on anterior edge of the gill arches.

granular yolk Yolk consisting of discrete units of finely to coarsely granular material.

head length Before development of the operculum, the distance from the most anterior part of head to most posterior part of auditory vesicle; following operculum formation, the distance from the most anterior part of head to the most posterior part of opercular membranes (excluding spines).

heterocercal Tail in which the urostyle is flexed upward and extends nearly to the tip of upper lobe of caudal fin.

holoblastic Type of cleavage in which the entire egg, including the yolk, undergoes division.

hypurals Expanded, fused, haemal spines of last few vertebrae which support caudal fin.

incubation period Time from fertilization of egg to hatching.

inferior mouth A mouth located near or on ventral side of head.

interorbital Space between eyes over top of head.

isthmus The narrow area of flesh in the jugular region between gill cavities.

jugular Pertaining to the throat.

juvenile Young fish after attainment of full adult counts and before sexual maturation.

keeled With a ridge or ridges.

larva Young fish between time of hatching and attainment of adult fin-ray complements.

late embryo Stage prior to hatching in which the embryo has developed the external characteristics of the hatching stage.

lateral line Series of sensory pores and tubes extending backward from head; complete when line extends to caudal base, incomplete when it does not.

mandible Lower jaw.

maxillary Upper jaw.

melanophores Black and brown chromatophores.

myomeres Serial muscle segments of the body of a fish.

nape Area on back of fish from occipital region to insertion of dorsal fin in spiny-rayed fish and back to about same length as occiput in soft-rayed fish.

nasal Pertaining to region of the nostrils.

notochord Longitudinal supporting axis of body which is eventually replaced by the vertebral column in teleostean fishes.

occipital region Area on dorsal surface of head of fishes, beginning above or immediately behind eyes and extending backwards to end of head.

oil globule(s) Discrete sphere(s) of fatty material within the yolk.

oil globule diameter Greatest diameter of oil globule.

olfactory buds Incipient olfactory organs.

optic vesicles Embryonic vesicular structures which give rise to the eyes.

otoliths Small, calcareous, secreted bodies within the inner ear.

P Abbreviation for pectoral fins.

palatine teeth Teeth on the paired palatine bones; in the roof of the mouths of some fishes.

pectoral bud Swelling at site of future pectoral fin; anlage of pectoral fin.

pectoral fins Paired fins behind head, articulating with pectoral girdle.

pelvic bud Swelling at site of future ventral (pelvic) fins; anlage of ventral fins.

pelvic fins Paired fins articulating with pelvic girdle; ventral fins.

peritoneum Membranous lining of abdominal cavity.

perivitelline space Fluid filled space between egg proper and egg capsule.

pharyngeal teeth Teeth attached to pharyngeal bones.

postanal myomeres The number of myomeres between a vertical line drawn from posterior margin of vent and the most posterior myoseptum. Last myoseptums in yolk-sac larva and early larva are frequently obscured, resulting in a low count.

prejuvenile Young fish in an intermittent stage between a larva and a juvenile.

preanal myomeres The number of myomeres between the most anterior myoseptum and a vertical line drawn from posterior margin of vent. This excludes the triangular area behind the auditory vesicle and anterior to the first myoseptum.

quadrate Squarish.

reticulated Having a network of lines.

scute Horny or bony plate, often spiny or keeled.

SL Abbreviation for standard length.

snout to vent length Distance from the most anterior aspect of snout to posterior margin of vent. The precise method of measuring is often not stated.

standard length In larval forms prior to completion of the hypural complex, the straight-line distance from the most anterior part of head to tip of urostyle or notochord; after completion of the hypural complex, the straight-line distance from most anterior part of head to end of hypural plate.

suctorial disc Adhesive organ.

TL Appreviation for total length.

total length Straight-line distance from the most anterior part of head to tip of tail. All length measurements given in older reference before the adoption of standard length are assumed to be total length.

total myomeres The sum of preanal and postanal myomeres.

urostyle Elongate last centrum of vertebral column.

V Abbreviation for the ventral or pelvic fins.

vent External oriface of the intestine; anus.

ventral fins Paired fins articulating with the pelvic girdle; pelvic fins.

vitelline vessels Arteries and veins of yolk region.

water-hardening Expansion and toughening of egg capsule due to absorption of water into the perivitelline space.

width of perivitelline space Distance between egg capsule and yolk, expressed as the ratio of width of perivitelline space to radius of egg capsule.

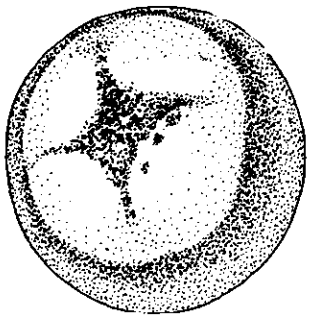
yolk Food reserve of embryonic and early larval stages, usually seen as a yellowish sphere diminishing in size as development proceeds.

yolk sac A bag-like ventral extension of the primitive gut containing the yolk.

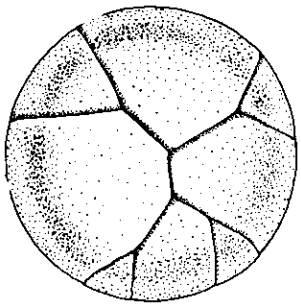
yolk-sac larva A larval fish characterized by the presence of a yolk-sac.

ORDER ACIPENSERIFORMES

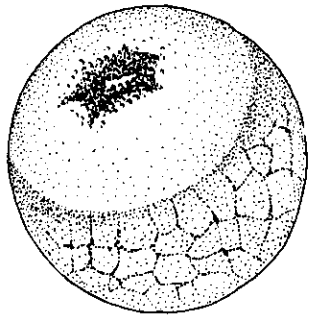
Acipenseridae - sturgeons
Acipenser oxyrhynchus - Atlantic sturgeon



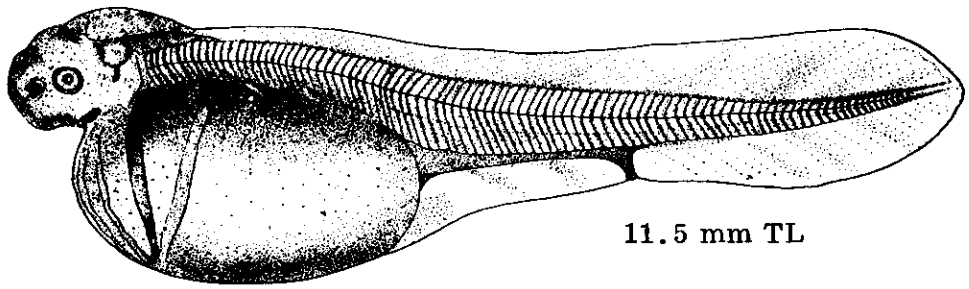
Before fertilization



Sixth cleavage
Late blastula



Lower pole



11.5 mm TL

Occurrence of sturgeon eggs or larvae within the Potomac river system is highly unlikely, although occasional sturgeon still appear in the commercial fisheries.

Spawning: Anadromous, brackish or freshwater.
Dates: April-May.

Eggs: Demersal, adhesive, attached. Drawings with capsule removed.
Size: 2.0-2.9 mm.
Characteristics: Opaque heavy eggs with semi-holoblastic cleavage, i.e., cell division includes yolk; brown to grey. Egg capsule 2-layered, thick. May be confused with gar eggs, but sturgeon eggs are smaller and earliest cleavage stages have distinctive cross-shaped pigment patch.

Larvae: Hatching size: 11 mm TL.

Characteristics: Opaque dark larvae; distinguished from gar larvae by absence of sucking disk. From illustrations assume high myomere count.

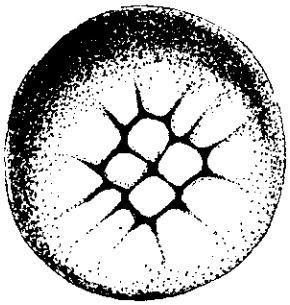
Adults: D. 30-46; A. 22-32; P. 40-41; V. 28-29.

References: Mansueti and Hardy, 1967; Ryder, 1890.

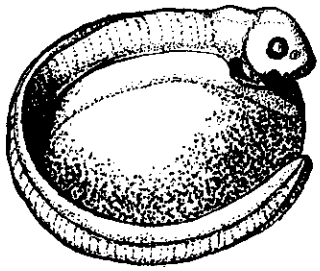
Illustrations: Eggs, after Dean, 1895; larva, Ryder, 1890.

ORDER SEMIONOTIFORMES

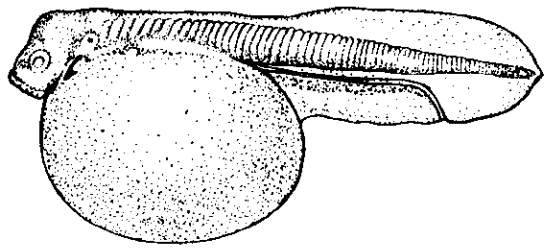
Lepisosteidae - gars
Lepisosteus osseus - longnose gar



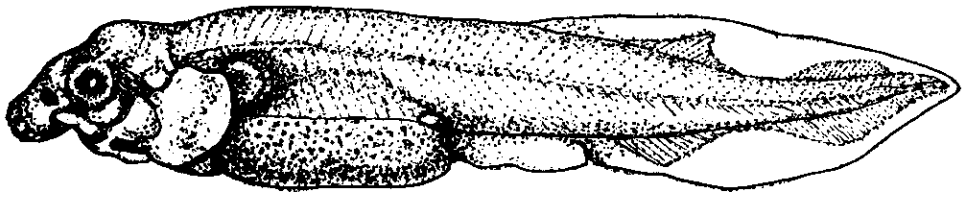
Sixteen cell stage



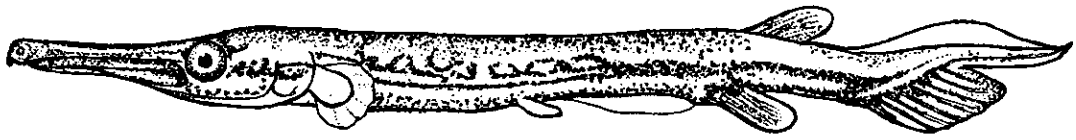
Late embryo



Yolk-sac larva



15 mm TL



41 mm TL

Although adults may range into brackish water, the occurrence of gar eggs and larvae in Potomac tidewaters is highly unlikely.

Spawning: Freshwater, shallow grassy areas.
Dates: May-June.

Eggs: Demersal, adhesive, attached. Drawings with capsule removed.
Size: 3.3-5.0 mm.
Characteristics: Opaque, heavy, semi-holoblastic cleavage, thick 2-layered capsule; grey to yellowish brown. Confused with sturgeon eggs except for larger size.

Larvae: Hatching size: 8-10 mm TL.

Characteristics: Suctorial disc distinguishes larval gar from any other species. Larvae with heavily pigmented, fleshy, rudimentary fins within finfold. Disc gradually reduced; disappearing by ca. 25-40 mm. May be confused with pike (Esox) larvae, but after disc has disappeared heterocercal tail immediately identify young as gar. Also dorsal and anal counts lower than in Esox.

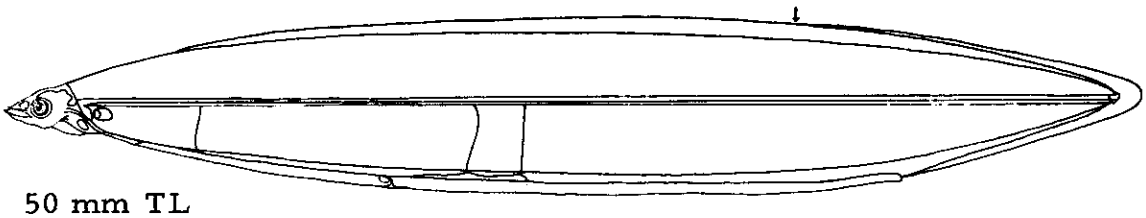
Adults: D. 6-9; A. 8-10; P. 10-13; V. 6.

References: Mansueti and Hardy, 1967; May and Gasaway, 1967.

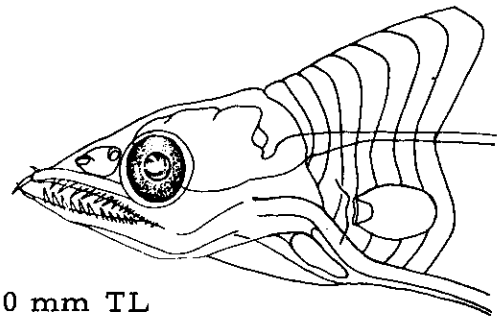
Illustrations: Eggs, larva, redrawn from Kerr, 1919; juvenile, Fish, 1932.

ORDER ANGUILLIFORMES

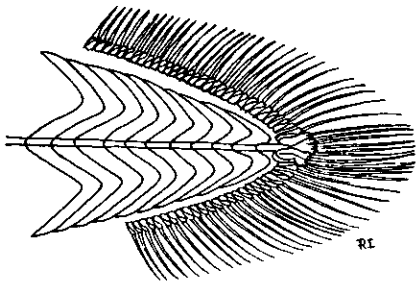
Anguillidae - freshwater eels
Anguilla rostrata - American eel



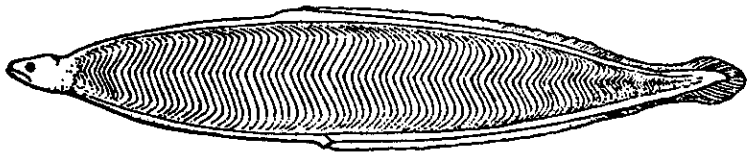
50 mm TL



50 mm TL



Detail of head and Tail



58 mm TL

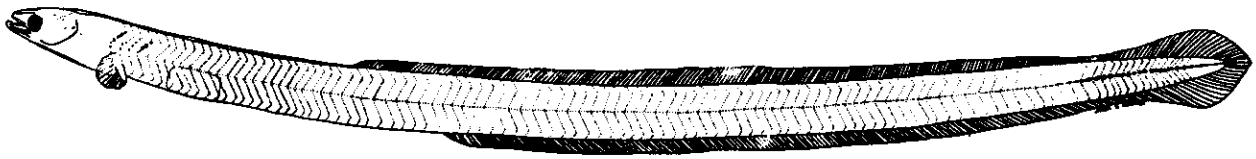
Both the American eel and conger eel spawn in the ocean, pass through a leptocephalus stage, and normally arrive in mid-Atlantic estuaries as post metamorphic, "glass eels." However, occasional leptocephali are found in the estuaries. American eel leptocephali have been collected in Delaware Bay; conger eel leptocephali in Raritan Bay, N.Y., and one leptocephalus of the speckled worm eel in Chesapeake Bay. The appearance and size of leptocephali and glass eels are so unique, they are immediately recognizable. There is always the possibility of other species of leptocephali as stragglers into mid-estuarine waters so care should be taken with identifications.

Spawning: At sea, winter.

Larvae: Leptocephalus, flat, transparent, very large teeth, reaches length of ca. 65 mm; myomeres 104-111 (avg. 107). It is one of only 2 west Atlantic leptocephali which lacks pigment, except in eye; other is Anarchias yoshiae (Muraeniche) (M. Fahay, personal communication).

During metamorphosis the leptocephalus stage undergoes a reduction in length to ca. 50 mm and both dorsal and anal fin origins and vent move forward until adult position is attained. Thus preanal and postanal myomere count changes radically. A 50 mm leptocephalus has 70 preanal and 34 postanal myomeres; a 52 mm glass eel, 37 preanal and 72 postanal myomeres (Eldred, 1968).

Anguilla rostrata - American eel



85 mm TL

Leptocephalus and glass eels distinguished from same stages of conger eels and speckled worm eels by smaller size, fewer myomeres and lack of pigmentation.

Adults: Dorsal fin origin well posterior to midpoint between gill openings and vent; well behind pectorals.

References: Hildebrand and Schroeder, 1928; Eldred, 1968; M. Fahay, personal communication.

Illustrations: Leptocephali, 50 mm, Eldrid, 1968; 58 mm, Hildebrand and Schroeder, 1928; glass eel, original illustration by John Cooper.